

a recent systematic review, over 60% of studies investigating the links between cognition and belief in psi have relied on undergraduate samples, and the remainder used predominantly general population samples or combined ones (Dean et al., 2022). Yet, many academic psi researchers are trained scientists and scholars (Cardeña, 2014). Even though they may exhibit a high level of endorsement of the reality of psi (Irwin, 2014), they likely differ in cognitive characteristics from the general population of lay believers. Importantly, within this group, high endorsement of psi phenomena, which would manifest as high scores on standardized measures of psi belief, may be strongly influenced by researchers' assessment of the published experimental evidence on psi (Irwin, 2014).

Cognitive styles related to evaluating evidence and reaching conclusions are of particular relevance to the controversial nature of psi, as they may contribute to how researchers (whether they are proponents or skeptics of psi) and lay individuals form beliefs about psi or engage with psi research. The literature on the "cognitive deficits hypothesis" of psi belief generally views deficient cognitive characteristics as responsible for (or at least associated with) strong psi beliefs. However, Cardeña (2011), among others, has argued that both staunch believers and skeptics who take an absolutist stance—fully endorsing or rejecting psi—have in common "intolerance for complexity and ambiguity" and unwillingness to consider other perspectives. In addition to actively open-minded thinking (AOT)—extensively investigated in relation to psi beliefs—another important albeit unexplored in this context cognitive style is the "need for cognitive closure," often shortened as "need for closure" (NFC). NFC captures individual differences in the motivation to seek closure during information processing when faced with a decision or judgment (Webster and Kruglanski, 1994). Specifically, NFC measures the tendency to quickly settle on an answer, even if it is not correct or optimal, to end further information processing, indicating a preference for any answer, as compared with confusion and ambiguity (Webster and Kruglanski, 1994; Neuberg et al., 1997). Individuals who score high on measures of NFC tend to be more "closed-minded, resistant to information inconsistent with their firm opinions, and reluctant to have their knowledge challenged" (Roets et al., 2015).

In this study, we investigated differences in cognitive styles (AOT and NFC) among four heterogeneous groups regarding belief in psi and attitudes toward and involvement in related research: academic psi researchers, lay psi believers, academic skeptics, and lay skeptics. This research sought to shed light on two main questions: (1) Are psi researchers different from lay believers in how they approach knowledge, evidence, and ambiguity? (2) Are psi researchers—who engage in this research as a legitimate scientific pursuit which can yield observations incompatible with physicalist

TABLE

Procedure

Each group of participants completed a single online questionnaire administered via Qualtrics (Provo, Utah, USA), a secure survey platform with a site license provided by the University of Virginia. The study protocol was approved by the University of Virginia's Institutional Review Board for Social and Behavioral Sciences (protocol #3926). Participants provided

for group differences in psi beliefs/experiences, cognitive styles, and participants' age, without adjusting for covariates. Analysis of covariance (ANCOVA) was used to test for these group differences while including covariates as additional independent variables in the models. Specifically, given previous findings of age and education associations with AOT and NFC (Kossowska et al., 2012; Chen, 2015; Edgcumbe, 2022), and differences in these demographic variables between groups in this study, we assessed group differences while adjusting for age and education as an ordinal variable.

Pairwise differences after a significant ANOVA/ANCOVA group effect were assessed via Tukey-adjusted post hoc tests. Effect sizes for the main effects of ANOVA/ANCOVA were presented as eta squared and partial eta squared. Pearson's chi-squared tests were used to test the association between group and categorical variables like sex and education. Pearson's correlation coefficients were used for all bivariate correlation analyses. All data management and statistical analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC).

Power analysis

Given the sample size limitations in this study, we conducted a post hoc sensitivity power analysis using G Power Version 3.1.9.7 (Faul et al., 2007). A one-way between-subjects analysis of variance with 144 participants and four groups would be sensitive to effects of $\eta^2 = 0.07$ or $f = 0.28$ (conventionally, a medium effect size), assuming 80% power and an alpha of 0.05. In other words, the study would not be able to reliably detect effects smaller than $\eta^2 = 0.07$. Note that G Power outputs effect sizes in Cohen's f , which has been converted to η^2 according to Cohen (2009).

To our knowledge, there are currently no established benchmarks in the particular groups included in this study for effect sizes or expected mean levels for the cognitive styles under examination. However, some prior research may inform reasonable estimates of group differences in AOT that are associated with objective measures of argument evaluation. Stanovich and West (1997) administered an argument evaluation test and various cognitive style measures to a large group of participants. The authors developed an index of one's ability to evaluate the quality of an argument independently of one's prior beliefs about an issue. Classifying participants into groups based on their high or low reliance on argument quality when evaluating a proposition, Stanovich and West (1997) reported that the high reliance group showed significantly higher disposition toward AOT compared to the low reliance group. Using descriptive statistics from the article, we calculated that the effect size of this difference approximates a Cohen's d of 0.51 (equivalent to f of 0.25 or η^2 of 0.06). For the NFC scale, we could not identify studies directly addressing associations with relevant objective measures. However, associations between NFC and measures relevant to evidence processing, such as intolerance for ambiguity, need for cognition, and dogmatism, fall in the range of 0.58–0.60 in terms of Cohen's d (f : 0.29–0.30 or η^2 around 0.08) (Webster and Kruglanski, 1994). The magnitude of such AOT and NFC effects are in line with what our sample allows us to detect.

Results

Demographic characteristics

Due to the nature of the participant groups, differences in demographics were expected. In terms of education, the two groups consisting primarily of academics—the academic psi and academic skeptic groups—had achieved higher education, on average, than the lay believers and skeptics (Table 1). In addition, the academic groups differed from the lay groups in terms of sex and age. Notably, the sex ratio among the academic psi group exactly mirrors previously published estimates (Mayer et al., 2022). Academic skeptics were the oldest, on average, and differed significantly from both the lay psi group ($p = 0.0001$) and the lay skeptic group ($p = 0.002$), but not from the academic psi group ($p = 0.27$). Participants in the academic psi group were significantly older than those in the lay psi group ($p = 0.03$) but not the lay skeptic group ($p = 0.17$).

Group differences in psi beliefs and experiences

As anticipated, there were differences between the groups on both psi beliefs ($p < 0.0001$, $\eta^2 = 0.89$) and experiences ($p < 0.0001$, $\eta^2 = 0.61$) (Table 1, Figure 1), as measured by the WEBS. Post hoc tests revealed that the academic psi and lay psi groups have significantly higher psi belief scores than both skeptic groups ($p < 0.0001$ for all four comparisons). Psi belief scores did not differ significantly between the two skeptic groups ($p = 0.99$). While both psi groups showed high levels of belief, participants in the academic psi group had significantly lower

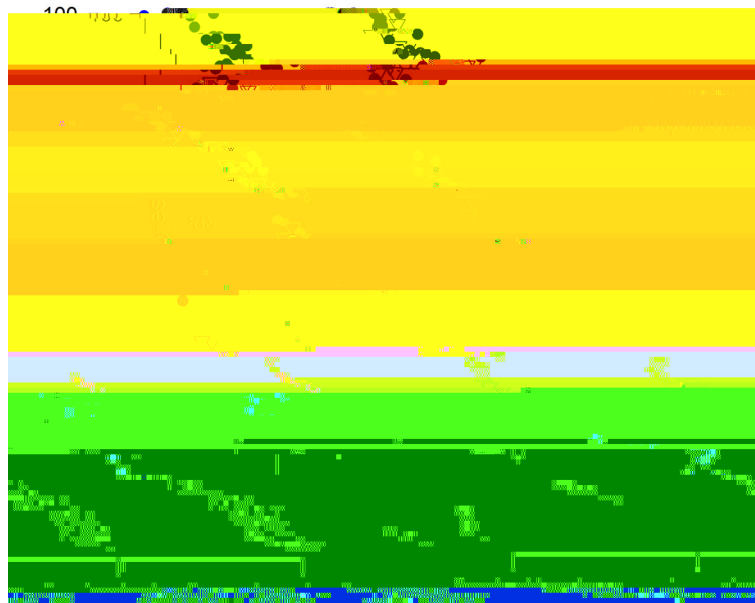


FIGURE
Dot plot showing Noetic Experiences and Beliefs Scale (NEBS) scores (Y-axis) by study group (X-axis). Academic psi ($N =$) and lay psi ($N =$) groups showed higher belief and experience scores than the academic skeptic ($N =$) and lay skeptic ($N =$) groups.

The lay psi group had significantly lower AOT scores than the academic psi ($p = 0.04$), academic skeptic ($p = 0.01$), and lay skeptic ($p = 0.005$) groups.



FIGURE

Scatterplot for the relationship between psi belief scores and actively open-minded thinking (AOT). Scores for each of the four groups are shown in different colors. Lines of “best fit” for the relationship are shown separately for the total sample (overall fit), the psi groups combined (psi fit), and the skeptic groups combined (skeptical fit). A small amount of jitter was added to values on both axes to facilitate visualization of overlapping points. AOT is negatively correlated with psi belief in the total sample and among the skeptic groups, but not the psi groups.

as well as how those experiences directly influenced their beliefs in psi. Some participants in this group specifically commented on the role of logic and evidence in their perceptions: “Myself, I’m very logical and what I experience of the energetic and spiritual world to me does not defy the science or contradict logic. If I can’t understand the spiritual and energy logically, I wouldn’t be involved in it.” Another wrote: “Paranormal Investigation is all about making sure there’s concrete evidence.” Additionally, several respondents in this group commented on how they and people in general can develop the ability to experience psi phenomena.

Discussion

In this manuscript, we aimed to test the hypothesis that academic psi researchers may exhibit different cognitive styles compared to lay individuals interested in psi, but similar to skeptics. We compared two cognitive styles relevant to evidence processing and judgments—actively open-minded thinking and the need for closure—between heterogeneous groups in terms of belief in psi and attitudes toward and involvement in psi research. Specifically, we included two groups of academics—psi researchers and skeptics—as well as two lay groups of participants who either believe in psi or are skeptics of it.

Comparing the academic psi and academic skeptic groups

A primary focus of this investigation was to compare academics and researchers who are engaged in studying psi and those who take a skeptical position toward this field and its underlying

phenomena. Not surprisingly given their different engagement with psi, researchers in the field reported significantly greater belief in and perceived experience with psi phenomena compared to academic skeptics, echoing prior findings (Blackmore, 1989; Irwin, 2014). However, as hypothesized, psi researchers and academic skeptics showed no difference in the cognitive styles of AOT and NFC. Together, these findings suggest that these two groups that are philosophically and empirically at odds with each other regarding evidence for psi phenomena nonetheless do not differ in their endorsement of the principles of “good” thinking about evidence (Baron et al., 2015). These encompass actively seeking out evidence that contradicts one’s beliefs, being willing to update one’s beliefs in light of new evidence, and being comfortable with ambiguity (Stanovich and Toplak, 2023). Additionally, the two groups did not differ in the extent to which they form opinions quickly to avoid ambiguity (Roets and Van Hiel, 2011).

Supporting the notion that these two groups are not entirely dissimilar, a previous survey comparing the views of psi researchers and skeptics revealed several areas of agreement (Blackmore, 1989). Among those were the acknowledgment of contributions of psi research to other fields (including psychology, statistics,

A more recent survey with members of the Parapsychological Association (PA) substantiated this, revealing that overall they deemed the cumulative experimental psi evidence most persuasive (79% combined for “strongly” or “extremely” persuasive) (Irwin, 2014). However, PA members also viewed spontaneous cases as well as personal experience as persuasive, though to a lesser extent (Irwin, 2014). This divergence was also reflected in our

Association between belief in psi and actively open-minded thinking

Across our entire sample encompassing diverse groups in terms of belief in psi and involvement in related research, AOT showed small-to-medium inverse correlations with psi belief and experiences. The direction of this relationship suggests that people who endorse beliefs in psi are less likely to endorse the principles of good thinking about evidence, including willingness to seek out evidence that contradicts their beliefs, to update their beliefs with new evidence, and to be comfortable with ambiguity. This association has been demonstrated previously, using heterogeneous measures of AOT and psi belief, in both undergraduate and adult samples (Pennycook et al., 2020; Rizeq et al., 2021; Newton et al., 2023). Notably, our participant selection differed not only in terms of demographics but also with the purposeful sampling at the ends of the psi belief spectrum. Relatedly, in our data, this association appears to be driven by the skeptic groups and is even stronger among them, but is virtually null within the psi groups. This suggests that the inverse relationship between actively open-minded thinking and belief in psi may not be universal, particularly among individuals with strong psi beliefs, which may be influenced by other factors.

Limitations

Our study has limitations that are worth noting, including some pertaining to the selection of participants. The samples of academic psi and academic skeptic individuals are likely representative of their underlying populations. However, participants in the lay groups may be different from non-selected individuals from the general population who may hold belief or skepticism toward psi, as the former were recruited through venues where they actively pursued their interests and appear to be highly educated compared to the general population. Additionally, participants in the different groups were not matched on demographics, but we also presented group

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